REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 15, 18, and 28 are pending in the present application, Claims 15 and 18 having been amended, Claim 28 having been added, and Claims 19 and 25-27 having been canceled without prejudice or disclaimer. Support for the present amendment is believed to be self-evident from the originally filed specification. Applicants respectfully submit that no new matter is added.

In the outstanding Office Action, Claims 15, 18, 19, and 25-27 were rejected under 35 U.S.C. §103(a) as unpatentable over Sugo et al. (U.S. Patent No. 5,308,467, hereinafter Sugo) in view of Liang et al. (U.S. Patent No. 6,649,037, hereinafter Liang).

Applicants respectfully submit that Claim 15 patentably distinguishes over Sugo and Liang. Claim 15 recites, *inter alia*,

> wherein, in a deionization compartment, one or more sheets of anion exchange fibrous materials and one or more sheets of cation exchange fibrous materials are alternately laminated on one another in a direction intersecting a water-passing direction from a water inlet to a treated water outlet of the deionization compartments such that opposite ends of each of the sheets of the anion exchange fibrous material and the sheets of the cation exchange fibrous material come into contact with both of an anion exchange membrane and a cation exchange membrane forming the deionization compartment.

Sugo and Liang, when taken in proper combination, do not disclose or suggest every element of Claim 15.

As an initial matter, it is respectfully submitted that the Office Action fails to set forth a *prima facie* case of obviousness. Page 2 of the Office Action states:

> It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Sugo by the teachings of Liang.

> One having ordinary skill in the art would have been motivated to do this modification, because Liang discloses the use of alternating layers of anion and cation resins in an electric deionization apparatus.

The Office Action fails to set forth an apparent reason to make the proposed modification. Rather, the Office merely offers circular and conclusory reasoning. In *Ex parte Whalen*, the Board of Patent Appeals and Interferences (BPAI) applied the legal standard set forth in *KSR*, and stated:

> The *KSR* Court noted that obviousness cannot be proven merely by showing that the elements of a claimed device were known in the prior art; it must be shown that those of ordinary skill in the art would have had some "apparent reason to combine the known elements in the fashion claimed." [1]

Thus, the outstanding rejection cannot stand and must be withdrawn because the Office Action does not establish a *prima facie* case of obviousness.

The invention defined by Claim 15 includes one or more sheets of anion-exchange fibrous material and cation-exchange fibrous material that are alternately laminated on one another so as to intersect a water-passing direction in the deionization compartment.

In non-limiting embodiments of the invention defined by Claim 15, large contacting areas of anion-exchange fibrous sheets and cation-exchange fibrous sheets are provided. As a result, a lot of water dissociation reaction is homogenously and easily caused. This water dissociation reaction is caused at a contacting point between the cation-exchange groups on the cation-exchange fibrous sheets and the anion-exchange groups on the cation-exchange fibrous sheets. Thus, sheets of anion exchange fibrous material and cation-exchange fibrous material provide a significantly greater number of contacting points between the cation-

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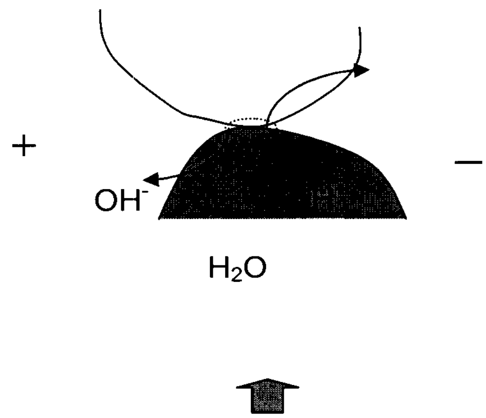
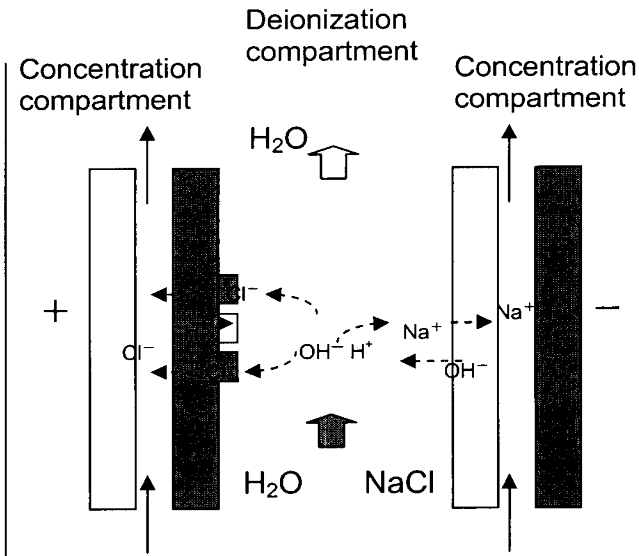
[1] *Ex parte Whalen*, Appeal 2007-4423 (BPAI, July 23, 2008) (precedential), p. 16 (quoting *KSR Int'l Co. v. Teleflex Inc.*, 82 USPQ2d 1385, (2007) (citations omitted).

exchange fibrous sheets and the anion-exchange fibrous sheets compared with the case of ion-exchange resins.

In the invention defined by Claim 15, opposite ends of each of the anion-exchange fibrous sheets and the cation-exchange fibrous sheets come into contact with both of the anion-exchange membrane and the cation exchange membrane forming the deionization compartment. Thus, all water flows through the anion-exchange fibrous sheets and cation-exchange fibrous sheets alternately. First, ions to be eliminated in the water are adsorbed to ion-exchange groups in the anion-exchange fibrous sheet and cation-exchange fibrous sheet, and a large number of H+ and OH- are generated by a water dissociation reaction. Next, H+ and OH- are ion-exchanged with their counter ions which have been adsorbed to the anion-exchange groups in the anion-exchange fibrous sheet and the cation-exchange groups in the cation-exchange fibrous sheet. The cation-exchange fibrous sheets and the anion-exchange fibrous sheets are alternately laminated in the deionization compartment while their opposite ends are contacted with the cation-exchange membrane and anion-exchange membrane. Thus, the adsorbed cation, for example sodium ions and hydrogen ions to the ion-exchange sheets move to the cation exchange membrane. Because of the water dissociation reaction and large contact area of the anion-exchange membrane and the cation-exchange fibrous sheets, the absorbed ions on the cation-exchange fibrous sheets move into the concentration compartment via the anion exchange membrane easily. Similarly, the absorbed anions, for example chlorine ions to the anion-exchange fibrous sheets move into the concentration compartment via the cation exchange membrane easily. Repeating these steps, ions to be eliminated are rapidly transferred from one ion-exchange group to next ion-exchange group and finally pass through the ion-exchange membranes. The above discussion is illustrated in the following drawings.

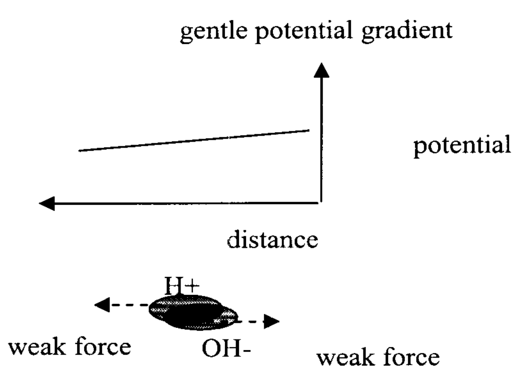


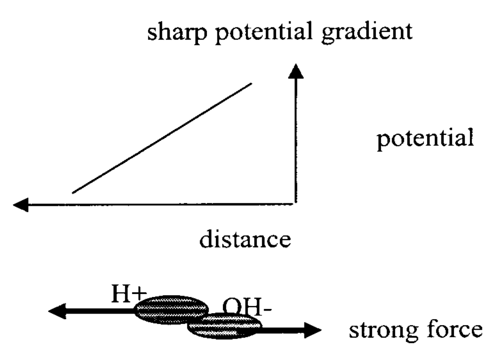
Water dissociation is caused at a point where electric potential difference between cation and anion is large. At a contacting point between anion and cation, functional groups are adsorbed to each other to neutralize.



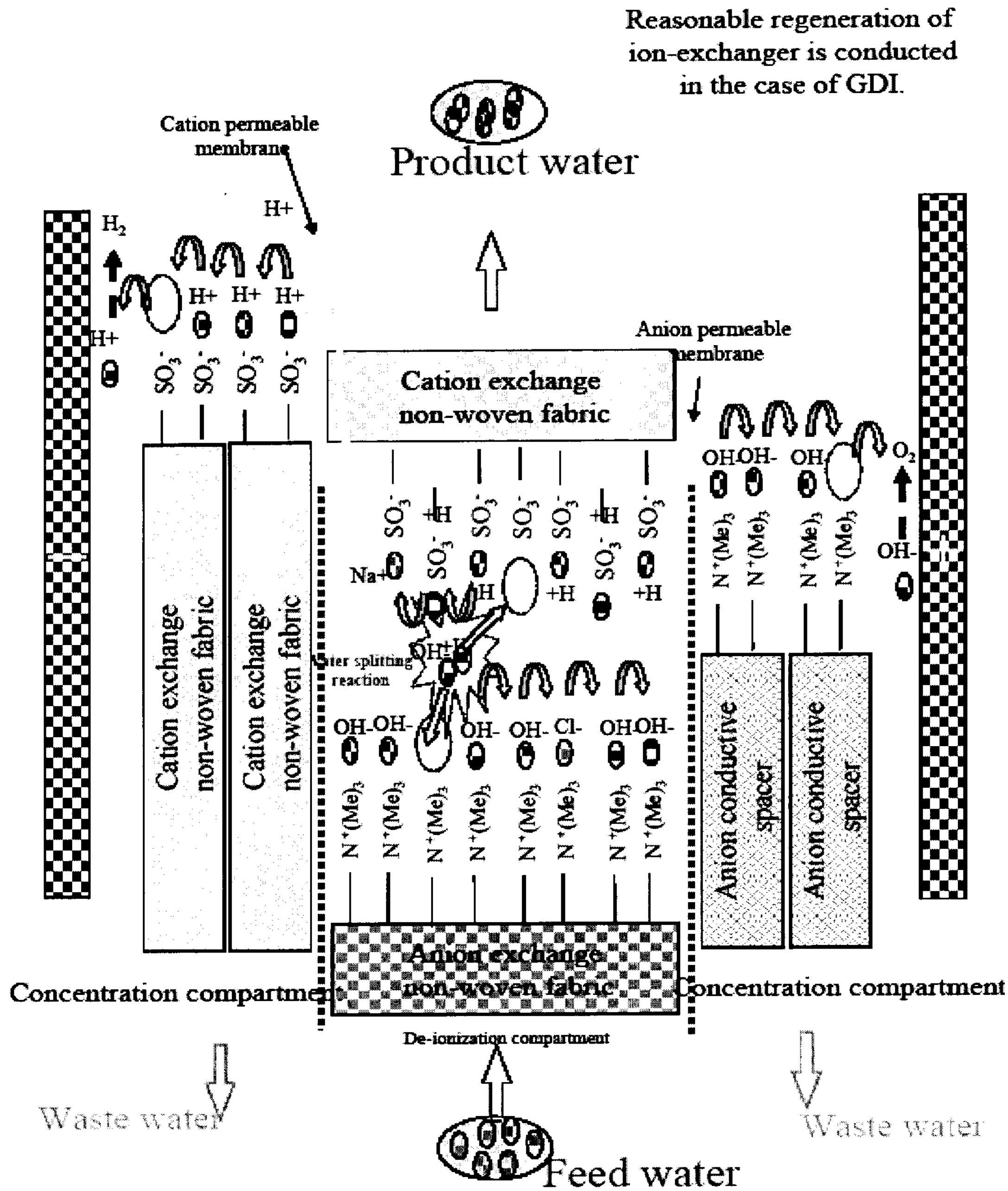
The adsorbed sodium ions to the ion-exchange fibrous sheets move into the concentration compartment via the cation-exchange membrane.
Because of water dissociation reaction and large contact area of the anion-exchange membrane and the cation-exchange fibrous sheets, so that the absorbed sodium ions to the cation-exchange fibrous sheets move into the concentration compartment via the anion-exchange membrane easily.
Similarly, the absorbed chlorine ions to the anion-exchange fibrous sheets move into the concentration compartment via the cation-exchange membrane easily.

Supplemental explanation of water dissociation reaction



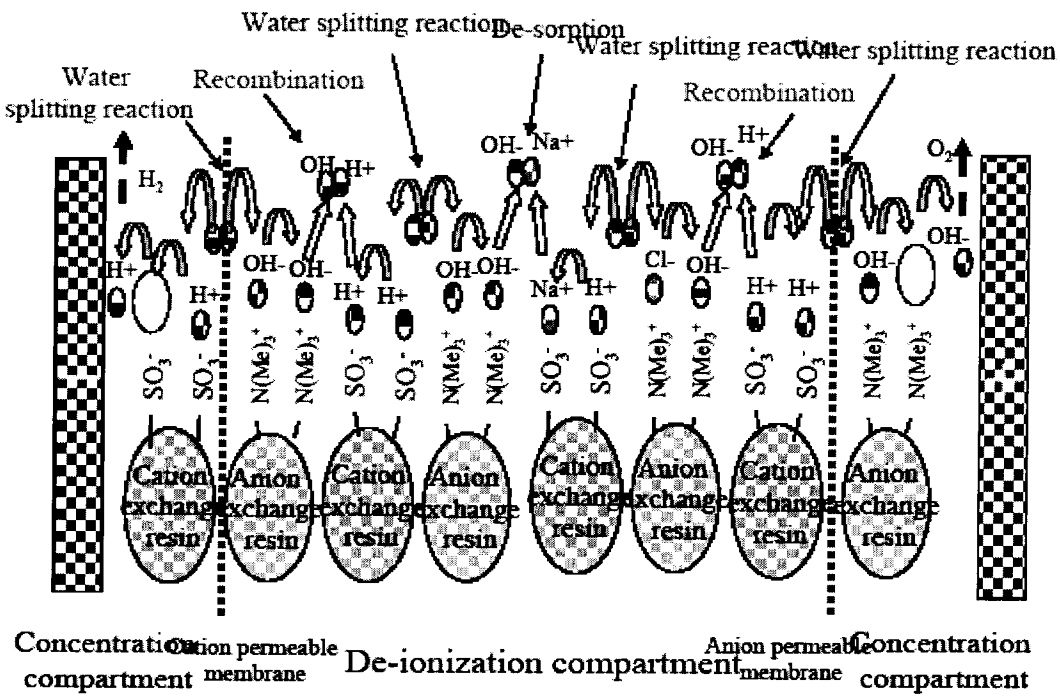


water dissociation reaction


Reasonable regeneration of ion-exchanger is conducted in the case of GDI.
Cation permeable membrane
Product water
Anion permeable membrane
Cation exchange non-woven fabric
Cation exchange non-woven fabric
Cation exchange non-woven fabric
Water splitting reaction
Anion conductive spacer
Anion conductive spacer
Anion exchange non-woven fabric
Concentration compartment
Concentration compartment
De-ionization compartment
Waste water
Waste water
Feed water

Reasonable regenaration of ion-exchanger is not conducted in the case of EDI.

The water splitting and recombination reaction occurs everywhere and the de-sorption also occurs in the mixed bed. Therefore, adsorbed ions are hard to move through solid phase to the direction of electrodes. The electric energy used for water splitting reaction changes into heat by recombination and de-sorption.



Page 2 of the Office Action states "The Sugo patent fails to disclose the use of laminated anion and cation fibrous material, rather it uses a mosaic or one sheet." Thus, Sugo does not disclose or suggest the above-noted elements of Claim 15. The outstanding Office Action relies upon Liang to cure the above-noted deficiencies in Sugo. Applicants respectfully traverse this position.

Sugo describes a mosaic ion-exchanger that is disposed parallel to water to be treated in a demineralizing compartment. In Sugo's apparatus, there are spaces between the mosaic ion-exchanger and a frame of the demineralizing compartment since they are in parallel. Thus, a part of the water bypasses the mosaic ion-exchanger without contacting the mosaic ion exchanger.

Further, the mosaic ion exchanger shown in Figs. 3 and 4 of Sugo includes spaces between anion-exchanger regions and cation-exchanger regions. This means that one mosaic ion exchanger includes regions where water does not contact with the ion-exchange groups. In addition, since the anion-exchange region and cation-exchange region do not adhere tightly, water dissociation reaction for causing regeneration of ion-exchanger hardly occurs. Thus, a part of the water does not contact with the ion exchange groups so that removal of ions is not efficiently conducted.

Liang describes that a cell may contain layered ion-exchange material in Fig. 6. The ion-exchange materials used in Liang are granulated ion-exchange resins. As to Liang's configuration, at least a part of the water flows through spaces between the ion-exchange resins. Examples in Liang show that locating a mixed bed after a layered bed is necessary to obtain water having sufficient purity.

The invention defined by Claim 3 differs from Sugo and Liang in that Claim 3 describes opposite ends of each of the anion-exchange fibrous sheets and the cation-exchange fibrous sheets come into contact with both of the anion-exchange membrane and the cation

exchange membrane forming the deionization compartment, which indicates that all water flows through the anion-exchange fibrous sheets and cation-exchange fibrous sheets alternately.

Moreover, a skilled artisan could not easily conceive of filling sheets of anion-exchange fibrous material and cation-exchange fibrous material in the deionization compartment so as to intersect the water-passing direction in the deionization compartment based on the descriptions of Sugo and Liang since the width of the deionization compartment is very narrow (i.e., about 2 mm to about 20 mm).

In the case that one or more mosaic ion-exchangers described in Sugo are layered as in Fig. 6 of Liang, the layered ion-exchange material is the mixed ion-exchange material, and not the alternately laminated anion-exchange fibrous sheet and cation-exchange fibrous sheet. Thus, a person of ordinary skill in the art could not properly combine Sugo and Liang to arrive at the claimed

> wherein, in a deionization compartment, one or more sheets of anion exchange fibrous materials and one or more sheets of cation exchange fibrous materials are alternately laminated on one another in a direction intersecting a water-passing direction from a water inlet to a treated water outlet of the deionization compartments such that opposite ends of each of the sheets of the anion exchange fibrous material and the sheets of the cation exchange fibrous material come into contact with both of an anion exchange membrane and a cation exchange membrane forming the deionization compartment.

In addition, water dissociation reaction to regenerate ion-exchange groups does not occur sufficiently in the cited references since the ion-exchange regions of the mosaic ion-exchanger are not contacted with each other. Such an embodiment differs from the invention defined by Claim 15. Further, a part of the water flows through the non-ion-exchanger regions of the mosaic ion-exchanger of Sugo since the mosaic ion-exchanger includes non-ion-exchanger regions. In such a case, a water dissociation reaction does not occur.

Even if the laminated ion-exchangers shown in Liang are laterally compression molded

as shown in Sugo, a part of the water to be treated flows through spaces between the striped ion-exchanger and the frame of the deionization compartment without contacting with the striped ion-exchanger.

In view of the above-noted distinctions, Applicants respectfully submit that Claim 15 (and any claims dependent thereon) patentably distinguish over Sugo and Liang, taken in proper combination.

Applicants respectfully submit that amended Claim 18 patentably distinguishes over Sugo and Liang, when taken in proper combination. Amended Claim 18 recites, *inter alia*,

> wherein, in a deionization compartment, one or more sheets of anion exchange fibrous materials and one or more sheets of cation exchange fibrous materials are alternately laminated on one another in a direction intersecting a water-passing direction from a water inlet to a treated water outlet of the deionization compartment such that opposite ends of each of the sheets of the anion exchange fibrous materials and the sheets of the cation exchange fibrous material ***come into contact with both of a sheet of anion exchange fibrous material and a sheet of cation exchange fibrous material which are respectively disposed in parallel with the surface of the anion exchange membrane and the surface of the cation exchange membrane forming the deionization compartment***.

Claim 18 recites elements analogous to those of Claim 15, and patentably distinguishes over Sugo and Liang for reasons similar to those state above regarding the laminated anion and cation fibrous material. However, Claim 18 further recites "that opposite ends of each of the sheets of the anion exchange fibrous materials and the sheets of the cation exchange fibrous material ***come into contact with both of a sheet of anion exchange fibrous material and a sheet of cation exchange fibrous material which are respectively disposed in parallel with the surface of the anion exchange membrane and the***

surface of the cation exchange membrane forming the deionization compartment. " The combination of Sugo and Liang also does not disclose or suggest the above highlighted feature of amended Claim 18.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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